1977 VIRUS TOLERANCE RATINGS FOR CORN STRAINS
Grown in the Lower Corn Belt

In cooperation with
Missouri Agricultural Experiment Station and
Ohio Agricultural Research and Development Center

May 1978

NORTH CENTRAL REGION

SCIENCE AND EDUCATION ADMINISTRATION • U.S. DEPARTMENT OF AGRICULTURE

Preface

In continuing research to measure corn tolerance to natural virus infection by maize dwarf mosaic and maize chlorotic dwarf, breeders and researchers grew selected corn strains in test plots in lower parts of the Corn Belt. The results of these tests are given in this publication in two parts—corn strains grown in Missouri and those grown in Ohio.

Observers of the individual corn plants rated symptoms on a scale from 1 (no virus symptoms) to 9 (complete susceptibility). Infections varied in intensity between hybrids and inbreds. At all test locations, johnsongrass, an alternate host, was abundant near the plots. The rating variations within tests of inbreds and single cross and double cross hybrids are shown in tables in this publication.

On January 24, 1978, four USDA agencies—
Agricultural Research Service (ARS),
Cooperative State Research Service (CSRS),
Extension Service (ES), and
National Agricultural Library (NAL)—
merged to become a new organization,
Science and Education Administration (SEA),
U.S. Department of Agriculture.

This publication was prepared by the Science and Education Administration's Federal Research staff, which was formerly the Agricultural Research Service.

Virus Tolerance Ratings of Corn Strains Grown in Missouri[1]

J. R. Wallin, M. S. Zuber, A. J. Keaster, R. D. Sheeley and D. V. Loonan[2]

This study identifies corn strains evaluated in 1977 that exhibit tolerance to maize dwarf mosaic virus (MDMV) and maize chlorotic dwarf virus (MCDV). These results will be useful to growers for identifying hybrids with high levels of tolerance that are to be planted in areas of high virus incidence. Corn strains planted at two Missouri locations were rated for MDMV and MCDV symptoms under conditions of natural infection. Test plots were located at the Bonacker Farm near House Springs, Jefferson County, and at the Delta Center Experimental Farm, Portageville, Pemiscot County.

Corn inbred lines, S_1 lines, single crosses, three-way and double crosses were planted with a four-row custom planter in single-row plots consisting of 20 plants. Plants were spaced 1 foot apart. Each plot was replicated either two or three times, depending upon the experiment.

Planting at Portageville was delayed until May 10 and at House Springs until May 18 to encourage high levels of virus infection from johnsongrass, an alternate host for the corn virus strains involved here. This grass is abundant and grows head tall in and near the test plots at both locations.

[1]Cooperative investigation between Science and Education Administration-Federal Research (SEA-FR), U.S. Department of Agriculture (USDA) and the University of Missouri Agricultural Experiment Station, Columbia. Journal Series No. 8040.

[2]Research plant pathologist, SEA-FR, USDA; professor of agronomy, associate professor of entomology and research specialist, University of Missouri, and research technician, SEA-FR, USDA. All of Columbia, Mo.

Virus incidence

MDMV and MCDV were identified by plant symptoms at both locations. MDMV gives a typical mosaic pattern, whereas, MCDV produces a vein clearing on infected leaves. Johnsongrass is the alternate host for both viruses. The corn leaf aphid, *Aphis maidis*, and possibly other aphids, are vectors for MDMV that can be transmitted mechanically. The leafhopper, *Graminella nigrifrons*, is the vector for MCDV that cannot be transmitted mechanically.

Each plant within a single-row plot was rated, for virus symptoms, on a 1 to 9 severity scale, with 1 = no symptoms to 9 = death of the plant. The ratings were made mainly for severity and not for specific types of virus. The plot mean was the average of the individual plant ratings. For each entry, replications were averaged to obtain the final rating.

MDMV was the predominate virus at both locations. The 1977 average virus rating at House Springs for the tolerant single cross, Mo14W×Oh713 was 2.66, lower than the average for the previous years beginning 1972 and much lower than 1976 (table 1). The susceptible single cross, Mo5×H55, was the same rating, 6.88, as 1976 but lower than the 9-year average.

At the Delta Center, the average ratings were considerably lower than in 1976 for both crosses; the tolerant cross rated 1.14 and the susceptible cross rated 6.65, just above the 9-year average.

In general, lower incidence of virus symptoms in field corn was reported from various areas of

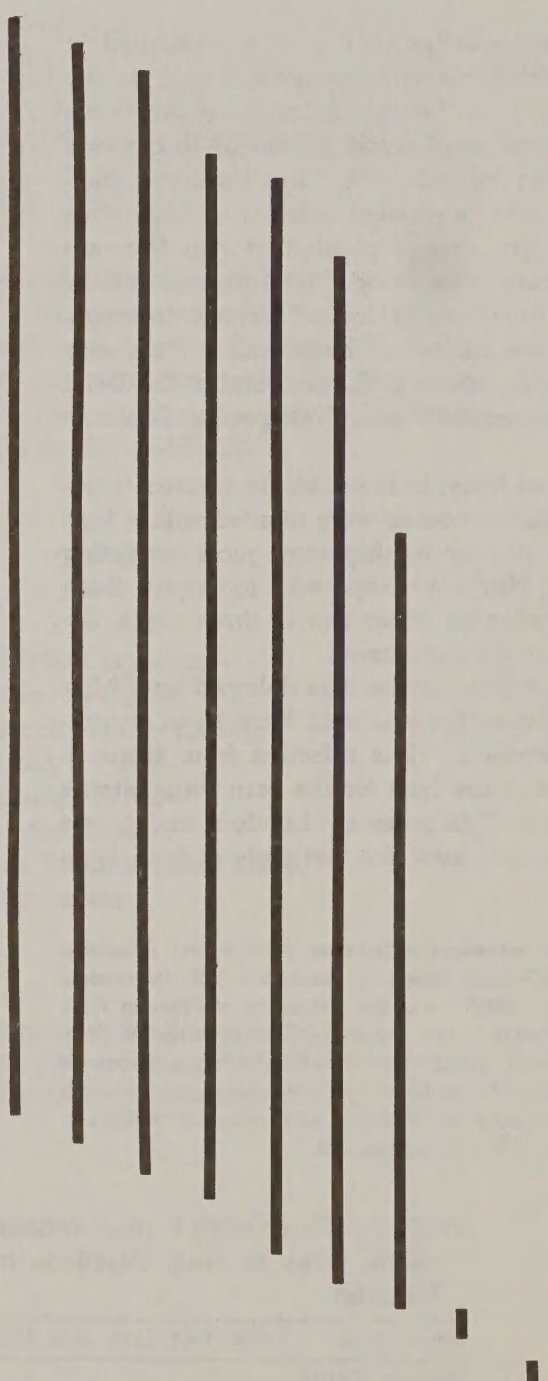
Table 1.—Comparative virus ratings[1] for a susceptible and tolerant single cross to virus infections for 10 years at two locations in Missouri

Single cross	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Average
Jefferson County											
Mo5×H55	8.00	8.20	7.30	7.60	7.00	7.00	8.20	7.50	6.80	6.83	7.44
Mo4W×Oh7B	1.67	5.81	4.00	4.70	2.33	1.30	3.60	1.70	4.00	2.66	3.17
Pemiscot County											
Mo5×H55	4.67	6.33	5.33	7.00	3.67	7.00	3.70	4.50	8.40	6.65	5.72
Mo14W×Oh7B	1.35	1.00	1.70	1.00	1.00	2.30	1.70	1.20	5.50	1.14	1.79

[1]Rating scale from 1 (no symptoms) to 9 (plant killed by virus).

Table 2.—1977 virus ratings for commercial plus two check hybrids grown at the Bonacker farm near House Springs, Jefferson County, Mo., planted May 17, 1977, experiment V-1

Hybrids	Ratings	DMRT[1/]
Cargill 256122	1.46	
DeKalb XL394	1.51	
Pioneer brand 3147	1.60	
ACCO AR65702	1.62	
Trojan X3214	1.68	
Trojan T1191	1.70	
Cargill 232020	1.88	
Cargill 246015	1.90	
McCurdy 7871	1.91	
Golden Harvest XC7014	2.02	
Funks G-4848	2.05	
PAG 246006	2.09	
Funks 27970	2.11	
McNair 508	2.12	
Northrup King PX715	2.17	
Trojan X112	2.17	
Golden Harvest H2660W	2.22	
Trojan MDM-116	2.27	
Pioneer brand 3145	2.29	
McCurdy 7882	2.32	
Northrup King PX95	2.33	
Golden Harvest H2740A	2.33	
Funks G-4776	2.35	
Funks G-4525	2.35	
Golden Harvest XC9016	2.35	
Northrup King PX79	2.39	
McNair X-233	2.40	
Cargill 99W	2.40	
Pioneer brand 3179	2.41	
ACCO VC9792	2.48	
ACCO AR66086	2.56	
NC+ 85	2.63	
PAG SX17A	2.64	
Mo14W x OH7B[2/]	2.66	
Northrup King PX737	2.72	
PAG 466001	2.72	
McNair 3121	2.73	
O's Gold SX3344	2.75	
DeKalb XL72B	2.78	
McNair X-160	2.80	
O's Gold SX5353	2.92	
ACCO VC8951	2.93	
McCurdy 9251	3.00	
NC+ 59	3.10	
NC+ X6540	3.21	
O's Gold SX5500	3.27	
PAG 446022	3.28	
NC+ 4666	3.47	
McCurdy MSX70	3.81	
O's Gold EXP5516	4.94	
H55 x Mo5[2/]	6.83	
Coefficient of variation. . . . . .percent	21.2	
Least significant difference.	1.2	



[1/] Duncan's Multiple Range Test - Entries with the same line in common are not considered significantly different at the 5% level.

[2/] Check hybrids

Table 3.—1977 virus ratings for commercial plus two check hybrids grown at the Delta Center near Portageville, Pemiscot County, Mo., planted May 9, rated August 16, 1977, experiment V-2

Hybrids	Ratings	DMRT[1/]
ACCO AR65702	1.03	
Northrup King PX95	1.03	
Northrup King PX79	1.05	
Funks G-4776	1.08	
McCurdy 7871	1.08	
Mo14W x OH7B[2/]	1.14	
Golden Harvest XC9016	1.17	
Golden Harvest H2740A	1.18	
Northrup King PX715	1.19	
Trojan T1191	1.24	
Trojan X112	1.24	
Pioneer brand 3145	1.26	
PAG 466001	1.27	
McNair 508	1.28	
Cargill 232020	1.30	
Trojan X3214	1.31	
Pioneer brand 3179	1.31	
Golden Harvest XC7014	1.31	
DeKalb XL394	1.38	
Cargill 99W	1.38	
Funks G-4848	1.44	
PAG 246006	1.45	
McNair X-233	1.46	
McCurdy 9251	1.64	
Cargill 256122	1.67	
Northrup King PX737	1.67	
McCurdy 7882	1.74	
PAG SX17A	1.78	
Funks G-4525	1.79	
Cargill 246015	1.80	
Trojan MDM116	1.86	
Funks 27970	1.92	
ACCO VC9792	1.94	
Pioneer brand 3147	2.02	
McNair 3121	2.04	
ACCO AR66086	2.05	
NC+ X6540	2.13	
McNair X-160	2.15	
DeKalb XL72B	2.18	
Golden Harvest H2660W	2.23	
NC+ 59	2.37	
PAG 446022	2.51	
O's Gold SX3344	2.61	
McCurdy MSX70	2.61	
O's Gold EXP5516	2.68	
NC+ 4666	2.99	
O's Gold SX5353	3.06	
ACCO VC8951	3.17	
O's Gold SX5500	3.80	
NC+ 85	4.99	
H55 x Mo5[2/]	6.65	
Coefficient of variation. . . . . .percent	29.7	
Least significant difference.	1.24	

1/ Duncan's Multiple Range Test - Entries with the same line in common are not considered significantly different at the 5% level.

2/ Check hybrids

Table 4.—1977 virus ratings for inbred lines in the Southern Corn Improvement Conference Uniform Test grown on Bonacker's Farm near House Springs in Jefferson County, Mo., planted May 17, rated August 2, 1977, experiment V-5

Inbred	Ratings	DMRT[1/]
T143	3.18	
T240	3.46	
TX601	3.79	
T232	4.15	
GA209	4.37	
Mo17c	4.67	
SC229	5.20	
OH513	5.94	
MP490	7.48	
KY21	7.98	
Coefficient of variation . . . . . .percent	18.27	
Least significant difference	1.56	

1/ Duncan's Multiple Range Test - Entries with the same line in common are not considered significantly different at the 5% level.

Table 6.—1977 virus ratings for corn rootworm resistant inbreds grown at the Bonacker Farm near House Springs, Jefferson County, Mo., planted May 17, rated August 2, 1977, experiment V-7

Entry number	Pedigree	Rating	DMRT[1/]
19	(Mo22 x A251)S_{12}	3.31	
18	(Mo22 x Mo12)S_{12}	3.71	
3	(Mo22 x A251)S_{12}	4.15	
20	(Mo22 x A251)S_{12}	4.98	
2	(N28A x Oh41)S_{10}	5.25	
10	(Mo22 x A251)S_{12}	5.29	
5	(Mo12 x A251)S_{12}	5.60	
6	(A251 x Mex Syn17)S_{12}	5.64	
26	B37	6.05	
21	Mo40	6.08	
23	Mo42	6.11	
7	(PP20 x SD10)S_{12}	6.25	
14	(Mo12 x B57)S_{10}	6.48	
25	Mo17	6.56	
16	(B57 x B46)S_{12}	6.64	
1	(B57 x B46(S_{9}	6.69	
12	(B8 x B57)S_{11}	6.72	
24	Mo43	6.83	
22	Mo41	6.93	
28	N28	6.94	
15	(B57 x B14A)S_{11}	7.00	
9	(A257 x Mex Syn17)S_{11}	7.10	
27	B14A	7.23	
4	(Mo22 x Mex Syn17)S_{12}	7.31	
17	(Mo22 x Mo12)S_{12}	7.45	
13	(Mo22 x Mo12)S_{10}	7.49	
8	(Mo12 x SD10)S_{12}	7.72	
11	(Mo12 x SD10)S_{11}	8.05	
Coefficient of variation. . . . . .percent	17.4		
Least significant difference.	1.70		

1/ Duncan's Multiple Range Test - Entries with the same line in common are not considered significantly different at the 5% level.

Table 5.—1977 virus ratings for inbred lines in the Southern Corn Improvement Conference Uniform Test grown at the Delta Center near Portageville, Pemiscot County, Mo., planted May 9, rated August 16, 1977, experiment V-6

Inbred	Ratings	DMRT[1/]
TX601	4.40	
T232	5.96	
T143	6.51	
T240	6.72	
GA209	6.74	
Mo17c	7.36	
OH513	7.50	
MP490	7.79	
SC229	7.96	
KY21	8.22	
Coefficient of variation . . . . . .percent		8.52
Least significant difference		1.25

[1/] Duncan's Multiple Range Test - Entries with the same line in common are not considered significantly different at the 5% level.

Table 7.—1977 virus ratings for corn rootworm resistant inbreds grown at the Delta Center near Portageville, Pemiscot County, Mo., planted May 9, rated August 16, 1977, experiment V-8

Entry number	Pedigree	Rating	DMRT[1/]
13	(Mo22 x Mo12)S_{10}	5.34	
19	(Mo22 x A251)S_{10}	5.68	
18	(Mo22 x A251)S_{12}	5.72	
6	(A251 x Mex Syn17)S_{12}	6.10	
2	(N38A x Oh41)S_{10}	6.14	
3	(Mo22 x A251)S_{12}	6.20	
23	Mo42	6.20	
10	(Mo22 x A251)S_{12}	6.28	
17	(Mo22 x Mo12)S_{12}	6.52	
5	(Mo12 x A251)S_{12}	6.59	
14	(Mo12 x B57)S_{10}	6.69	
20	(Mo22 x A251)S_{12}	6.69	
1	(B57 x B46)S_{9}	6.70	
7	(PP20 x SD10)S_{12}	6.71	
9	(A257 x Mex Syn17)S_{11}	6.72	
28	N28	6.73	
25	Mo17	6.84	
26	B37	6.89	
8	(Mo12 x SD10)S_{12}	6.93	
15	(B57 x B14A)S_{11}	6.97	
24	Mo43	6.99	
12	(B8 x B57)S_{11}	7.04	
11	(Mo12 x SD10)S_{11}	7.08	
27	B14A	7.18	
16	(B57 x B46)S_{12}	7.18	
21	Mo40	7.23	
4	(Mo22 x Mex Syn17)S_{12}	7.50	
22	Mo41	7.72	
Coefficient of variation. . . . . .percent			4.94
Least significant difference.			0.94

[1/] Duncan's Multiple Range Test - Entries with the same line in common are not considered significantly different at the 5% level.

the state. Presumably, this was attributed to less stress during July and August because of greater rainfall and lower maximum temperature during 1977.

Commercial hybrids

Virus ratings were made on 49 commercial hybrids[3] and 2 check hybrids at House Springs (table 2, exp. V-1) and at the Delta Center (table 3, exp. V-2). At House Springs, no significant difference was detected among 42 of the 49 commercials tested. All 42 hybrids rated less than 3, which was less virus than occurred in 1976. At the Delta Center, virus ratings were much lower than in 1976, indicating less virus development. No significant difference was noted between 42 of the 49 commercial hybrids, which all rated 2.51 or less. Only three hybrids rated greater than 3.5 while, in 1976, none rated that low. Again, as in 1976, the lack of significant differences in virus ratings between the majority of the hybrids indicated increased tolerance among the new commercial hybrids.

Uniform test of southern corn inbred lines

Ten inbred lines in the Southern Corn Improvement Conference Uniform Test were grown and rated at House Springs (table 4, exp. V-5) and Delta Center (table 5, exp. V-6). At House Springs, eight of the inbreds rated 5.9 or lower. Those that rated significantly better in this group were T143, T240, TX601, T232, GA209 and Mo17c. Virus development was more severe at the Delta Center as the ratings indicated. The lowest rating was 4.4 on TX601 and only five inbreds rated lower than 7.0. In addition to the above inbred, T232, T143, T240, GA209, and Mo17c rated significantly better than the remaining four inbreds, but TX601 stood alone.

Rootworm resistance lines

Twenty-eight inbred lines selected for rootworm resistance were planted at House Springs (table 6, exp. V-7) and at the Delta Center (table 7, exp. V-8).

At House Springs, 4 inbred lines rated 3.31 to 4.98 and were significantly more resistant than the other 24. All four lines contained Missouri inbreds. At the Delta Center, 8 inbred lines rated significantly better than the other 20. Six of these had Missouri germplasm and rated from 5.34 to 6.28.

Interestingly, six inbred lines exhibited the greatest resistance at both locations. Virus damage was slightly higher at the Delta Center but not as great as in 1976.

Conclusions

Virus symptoms and the infection level were less severe in 1977 than in 1976, which was one of the worst years at both test sites noted herein. The amount of precipitation was greater and temperature maxima were lower than in 1976. As the data indicate, corn strains differed in their degree of tolerance. A potential virus threat exists wherever johnsongrass grows; therefore, corn growers should select hybrids with the highest level of virus tolerance. Note from the data relating to the commercial hybrids reported here that several hybrids had levels of tolerance that should be suitable for planting in virus-problem areas.

Corn breeders have been quite successful in developing new hybrids with greater tolerance. During the past 7 years, the number of commercial hybrids with high levels of tolerance has increased.

Virus Tolerance Ratings of Corn Strains Grown in Ohio in 1977[4]

W. R. Findley, J. K. Knoke, and E. J. Dollinger[5]

Corn strains (inbred lines, exotic composites and hybrids) grown on the James Daulton Farm in the Ohio River Valley near Portsmouth, Ohio, were rated for virus diseases resulting from natural infection.

The Ohio Agricultural Research and Development Center (OARDC) sponsored a test of inbred lines and exotic composites, and the North Central Corn Breeding Research Committee (NCCBRC)

[3]Trade names are used solely to provide information. Mention of a trade name does not constitute warranty by the U.S. Department of Agriculture or an endorsement over other products not mentioned.

[4]Cooperative investigations of the SEA-FR, USDA; the Ohio Agricultural Research and Development Center, Wooster; and the Ohio Cooperative Extension Service.

[5]Research agronomist and research entomologist, SEA-FR, USDA, and professor of agronomy, OARDC, Wooster, Ohio 44691.

Table 8.—Incidence of maize dwarf mosaic virus (MDMV) on inbred lines and exotic composites in the Ohio Agricultural Research and Development Center test on July 22, 1977

Inbred or Composite	MDM-%	
Pa405	0	a[1]
Oh07	0	a
Oh7B	0	a
Oh513	0	a
Mo20W	0	a
N7B	0	a
(Compuesto Cubano)-S	0	a
(Compuesto Republica Dominicana)-S	0	a
(Nicarillo)-S	0	a
$PrMoS_1$ (75-28)	2.4	a-b
T232	2.5	a-b
Oh5145	2.5	a-b
Mo22	2.7	a-c
(Sint. Cristalino Amarillo)-S	2.8	a-c
GA209	2.8	a-c
(Compuesto Poblacion Cristalino)-S	3.0	a-c
Oh74-5232	4.2	a-c
$PrMoS_1$ (75-2)	4.2	a-c
(San Vicente, Barbados Comp.)-S	4.5	a-c
$PrMoS_1$ (75-75)	4.6	a-c
Oh(MDM)S2-#[4]-S-#-S[3]	4.8	a-c
Mo12	4.8	a-c
T(CM105)	5.0	a-c
T240	6.1	a-c
GT3	7.2	a-c
(Compuesto Cristalino Amarillo)-S	7.9	a-d
(Republica Dominicana x Cubano)-S	7.9	a-d
(Puerto Rico, Trin. Nor 330)-S	8.3	a-d
Ky66-2500	8.4	a-d
Mo18W	8.4	a-d
N6	9.4	a-d
$PrMoS_1$ (75-100)	9.8	a-d
CI.38B(Rec.)	10.0	a-d
(Antigua Republica Dominicana OB75)-S	10.1	a-d
Oh514	11.0	a-e
T143	12.5	a-f
Pa884P	12.7	a-f
Tx601	13.0	a-f
Oh514 Ht_1B	13.2	a-f
(Compuesto Semidentada Amarillo)-S	14.3	a-f
Oh5136	14.7	a-f
Oh509	14.7	a-f
(PD(MS)6xTuxpeno)-S	16.7	a-f
B54	16.7	a-f
Oh4531	17.0	a-f
JSA52-2	17.1	a-f
N141	17.4	a-f
N6J	17.6	a-f
GA203	19.5	a-f
J62-318	25.0	a-f
Va94	26.2	a-f
(Selec. Baja Antigua Gpo2)-S	27.9	a-f
Oh5146	28.3	a-f
33-16	28.8	a-f
CI.38B	29.6	a-f
CG1	29.7	a-f
Ky226	30.1	a-f
Ky61-2335	30.5	a-f
Ky128	30.7	a-f
H95	35.5	a-f
Va93	37.4	a-f
A96	37.5	a-f
B69	40.7	a-f
Oh509A	41.3	a-f
B79	41.4	a-f
Va35	42.9	a-f
A	46.1	a-f
B14A	48.0	a-f
(A-6)-S	50.0	a-f
E14-2-9	50.4	a-f
Oh516	53.2	a-f
A73	56.3	a-f
Ab28A	58.8	a-f
B37	61.0	a-f
B73	71.9	a-f
E38-11-11-5	72.6	a-f
K61-1	75.0	a-f
B14	75.9	a-f
B77	87.5	b-f
Oh43	87.6	b-f
Mo5	88.1	c-f
C103	93.3	d-f
A509	93.4	d-f
M14	95.8	e-f
Oh517	96.9	f
Mo17	97.4	f
Coefficient of varation	118.6%	
Least significant difference	67.4	

[1]Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

sponsored a test of inbred lines. The hybrid test was conducted cooperatively with OARDC and the Ohio Cooperative Extension Service.

Seeds of the corn strains were planted in replicated plots on May 19, 1977. Plots were 18 feet long with aisles between plots of 4 feet and rows 36 inches apart. Twenty-five seeds from inbred and exotic composite plants were single-space planted per one-row plot. Seeds of each hybrid were planted in two-row plots, 60 seeds per row and later thinned to 36 plants. Inbreds and exotic composites were grown in two replications. The hybrids were grown in four replications.

Seedling emergence generally was good, resulting in satisfactory stands in nearly all plots. Weather conditions were generally favorable for corn growth. Short periods of dry weather prevailed from planting to mid-June and early to

Table 9.—Incidence of maize chlorotic dwarf virus (MCDV) on inbred lines and exotic composites in the Ohio Agricultural Research and Development Center test on July 22, 1977

Inbred or Composite	MCD-%	
K61-1	10.0	a-[1/]
Oh7B	19.4	a-b
Oh07	20.0	a-b
Oh74-5232	20.9	a-c
T143	25.0	a-d
(Compuesto Poblacion Cristalino)-S	28.4	a-e
(PD(MS)6xTuxpeno)-S	29.2	a-e
T(CM105)	29.3	a-e
PrMoS$_1$ (75-75)	35.5	a-f
(Compuesto Cubano)-S	37.5	a-g
PrMoS$_1$ (75-28)	38.1	a-h
A509	38.3	a-h
Pa884P	38.8	a-h
H95	39.5	a-i
Mo20W	41.9	a-j
(Nicarillo)-S	42.5	a-j
T232	44.2	a-k
(Sint. Cristalino Amarillo)-S	44.2	a-k
N6J	44.3	a-k
Oh517	46.9	a-l
Oh5145	48.6	a-l
GT3	49.3	a-m
B77	50.0	a-m
T240	51.2	a-m
(Republica Dominicana x Cubano)-S	52.7	b-n
PrMoS$_1$ (75-2)	54.2	b-n
(Antigua Republica Dominicana 0B75)-S	54.4	b-n
(Puerto Rico, Trin. Nor 330)-S	55.0	b-o
Oh514	55.3	b-o
Ky66-2500	55.6	b-p
Mo12	57.2	b-p
N141	57.6	b-q
Oh(MDM)S2-#-[4/]-S-#-S-[3/]	57.7	b-q
GA209	58.3	b-q
Oh513	58.9	b-q
N7B	59.8	b-q
A96	60.7	b-q
33-16	60.9	b-q
Pa405	61.1	b-q
(Compuesto Republica Dominicana)-S	62.5	c-q
Oh4531	63.5	d-q
C103	65.2	d-q
N6	65.3	d-q
(Compuesto Cristalino Amarillo)-S	65.8	d-q
CI.38B(Rec.)	65.9	d-q
Va94	65.9	d-q
Tx601	66.5	d-q
Oh509	67.1	d-q
JSA52-2	68.5	e-q
(San Vicente, Barbados Comp.)-S	68.6	e-q
Mo22	72.8	f-q
CG1	73.4	f-q
(Selec. Baja Antigua Gpo 2)-S	73.6	f-q
Oh509A	73.9	f-q
Mo17	74.5	f-q
(Compuesto Semidentada Amarillo)-S	75.0	f-q
Oh5136	77.4	f-q
(A-6)-S	79.2	g-q
B54	79.2	g-q
Ky128	79.5	g-q
Oh5146	80.0	n-q
A	81.8	i-q
Ky61-2335	83.4	j-q
GA203	83.4	j-q
CI.38B	84.1	j-q
B14A	85.4	k-q
Oh514 Ht$_1$B	86.8	l-q
PrMoS$_1$ (75-100)	87.4	l-q
Ky226$_1$	87.5	l-q
B79	87.5	l-q
Oh516	87.5	l-q
Oh43	88.1	l-q
B37	88.5	l-q
F14-2-9	89.8	m-q
A73	90.6	m-q
Ab28A	91.2	m-q
Mo18W	91.4	m-q
B73	93.8	n-q
Va93	94.6	n-q
M14	96.9	o-q
Mo5	97.6	p-q
Va35	97.9	p-q
B14	100.0	q
B69	100.0	q
J62-318	100.0	q
E38-11-11-5	100.0	q
Coefficient of variation	25.8%	
Least significant difference	33.4	

[1]Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

mid-August. Weeds were controlled until late in the season by herbicides and cultivation.

Virus incidence

Maize dwarf mosaic virus (MDMV) and maize chlorotic dwarf virus (MCDV) infection in trap plants averaged 37.9 and 1.6 percent, respectively, over a 20-week growing season. In 1976, the 20-week average infection of MDMV and MCDV in these trap plants was 60.5 and 5.4 percent. First MDMV infection appeared in the trap plants on May 22 and MCDV infection on May 29. The susceptible trap plants were potted 14-day-old WF9×Oh51A seedlings exposed for 7-day periods throughout the growing season.

Average readings for 25 inbred lines included in the 1976 and 1977 tests were for MDMV 45.7 and 25.5 percent, for MCDV 71.7 and 61.3 percent and for virus ratings 5.6 and 5.4.

Insect trappings indicated that populations of

Table 10.—Virus ratings on inbred lines and exotic composites in the Ohio Agricultural Research and Development Center test on August 17, 1977

Inbred or Composite	Virus rating	
Oh513	3.5	a-[1]
Mo20W	3.5	a
T143	3.5	a
Oh5145	3.8	a-b
(Antigua Republica Dominicana OB75)-S	3.8	a-b
PrMoS$_1$ (75-75)	3.8	a-b
Oh7B	4.0	a-b
N6J	4.0	a-b
(A-6)-S	4.0	a-b
(Nicarillo)-S	4.0	a-b
Oh07	4.3	a-c
Oh514	4.3	a-c
Pa405	4.3	a-c
PrMoS$_1$ (75-100)	4.3	a-c
Ky61-2335	4.5	a-c
T232	4.5	a-c
Ky66-2500	4.5	a-c
T(CM105)	4.5	a-c
H95	4.5	a-c
(Compuesto Republica Dominicana)-S	4.5	a-c
(San Vicente, Barbados Comp.)-S	4.5	a-c
(Sint. Cristalino Amarillo)-S	4.5	a-c
(PD(MS)6xTuxpeno)-S	4.5	a-c
(Compuesto Poblacion Cristalino)-S	4.5	a-c
(Republica Dominicana x Cubano)-S	4.5	a-c
N7B	4.8	a-d
N6	4.8	a-d
Pa884P	4.8	a-d
T240	4.8	a-d
Oh74-5232	4.8	a-d
Oh5136	4.8	a-d
(Compuesto Cubano)-S	4.8	a-d
(Puerto Rico,Trin.Nor 330)-S	4.8	a-d
Oh(MDM)S2-#-[4]-S-#-S-[5]	4.8	a-d
Oh4531	4.8	a-d
GA209	5.0	a-d
C103	5.0	a-d
Mo12	5.0	a-d
CI.38B(Rec.)	5.0	a-d
K61-1	5.0	a-d
JSA52-2	5.0	a-d
A509	5.0	a-d
A96	5.0	a-d
Oh514 Ht$_1$B	5.0	a-d
(Compuesto Semidentada Amarillo)-S	5.0	a-d
(Compuesto Cristalino Amarillo)-S	5.0	a-d
PrMo S$_1$ (75-28)	5.0	a-d
Ky226	5.3	a-e
PrMo S$_1$ (75-2)	5.3	a-e
Oh509	5.5	b-f
Oh509A	5.5	b-f
Oh517	5.5	b-f
GA203	5.5	b-f
B54	5.5	b-f
Mo22	5.5	b-f
Tx601	5.5	b-f
N141	5.5	b-f
(Selec.Baja Antigua GPo2)-S	5.5	b-f
CG1	6.0	c-g
Mo18W	6.0	c-g
Va94	6.0	c-g
33-16	6.0	c-g
B79	6.5	d-h
Oh43	6.5	d-h
GT3	6.5	d-h
Ky128	6.5	d-h
Va35	6.5	d-h
B37	7.0	e-i
Mo17	7.0	e-i
B14A	7.0	e-i
CI.38B	7.0	e-i
A73	7.0	e-i
B69	7.0	e-i
J62-318	7.0	e-i
A	7.0	e-i
Va93	7.0	e-i
Oh5146	7.0	e-i
E14-2-9	7.3	f-j
Oh516	7.5	g-j
Ab28A	7.5	g-j
B14	7.8	g-j
Mo5	8.0	h-j
B73	8.0	h-j
E38-11-11-5	8.5	i-j
M14	9.0	j
B77	9.0	j
Coefficient of variation	13.2%	
Least significant difference	1.4	

[1]Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

Graminella nigrifrons, the vector of MCDV were similar for 1976 and 1977. Populations of aphid vectors of MDMV were less in 1977 than in 1976.

Four strips of johnsongrass, 9 feet wide and spaced 50 feet apart, extended over the length of the test area. Any one test entry was no more than 25 feet from johnsongrass, the overwintering host of MDMV and MCDV viruses.

Symptoms of MDMV appeared as chlorotic patterns of mosaic, ring, fleck, mottle, and streak primarily on the youngest leaves. The diagnostic symptom for MCDV was chlorotic streaking in the smallest veins visible to the unaided eye. Severe infection of one virus often masked symptoms of the other.

Virus rating systems

Two systems for evaluating effects of the viruses were established. In the first system, disease incidence in the test entry was determined. Observations for symptoms of MDMV and MCDV were made on individual plants in the NCCBRC test on July 14 and on plants in the OARDC and hybrid test on July 22. In these tests dead plants were assumed infected with both MDM and MCD.

In the second rating system disease severity was determined. Virus ratings were made on August 17 in the OARDC test and on August 18 in the NCCBRC and hybrid tests. Plants were rated on a plot basis. Virus ratings which included degree of chlorosis and stunting were made on a scale ranging from 1 (no visible symptoms) to 9 (severe symptoms). Plant stunting was not associated with ratings of 3 or less. Plants rated 2 were faintly chlorotic and those rated 3 were distinctly chlorotic. Ratings of 4 to 9 indicated increasing degrees of stunting and chlorosis.

Coefficient of variation (C.V.) values and least significant differences (L.S.D.) at the 5 percent probability level were computed for percentage MDMV- and MCDV-infected plants and for virus ratings. The C.V. is useful for evaluating the test uniformity, the lower the C.V. the greater the degree of test uniformity. The L.S.D. is useful in determining differences that are not due to chance 19 times in 20. Comparisons should be related to a common standard. Entries that exceed the ranges indicated by Duncan's Multiple Range Test differ significantly at the 5 percent level.

Inbred evaluation

Percentages of MDMV- and MCDV-infected plants and mean plot virus ratings of the 36 inbred lines and exotic composite S_1's included in the OARDC test are in tables 8, 9, and 10. Many of the inbreds were tested in several previous years. Many strains appeared to have an acceptable level of tolerance to MDMV, however, the range of statistical significance was large and the C.V. was 118.6 percent. C.V. values for MCDV-infected plants and plot virus ratings were considerably lower, but ranges indicated for statistical significance were also large. All strains had some plants showing virus symptoms that were at least slightly stunted. Of the currently available inbred lines tested Oh07 and Oh7B ranked best for the three kinds of observations.

Data on inbred lines from the test sponsored by the NCCBRC are in tables 11, 12, and 13 for percentage MDMV- and MCDV-infected plants and mean virus ratings. Thirty-two experimental inbred lines and the standard check lines (WF9, H55, B14, B37, Oh7B, Oh43, Oh51A, W64A, W117 and W153R) were included in the test. Inbred Oh7B was the outstanding inbred in the test. As indicated by its virus rating some stunted plants were observed at the time these ratings were made.

Hybrid evaluation

Results of the hybrid test are reported in tables 14, 15, and 16 for MDMV- and MCDV-infected plants and mean plot virus ratings. Included were 48 (available and experimental) proprietary hybrids and 9 open-pedigree combinations. All hybrids tested had some plants with virus symptoms, however, several available combinations had high tolerance to the diseases. In more recent years, good tolerance has been found in hybrids of earlier maturity.

Conclusions

The virus disease complex in southern Ohio is known to consist of MCDV and at least several strains of MDMV. These strains are known to vary in frequency of occurrence from year to year. Tolerance to one strain or virus does not necessarily indicate tolerance to the others. Time of infection and amount of virus in a plant affects its degree of reaction to the diseases. In general corn strains that are tolerant remain relatively so each year, however, their degree of tolerance is associated with virus incidence. High tolerance to MDMV is more common than to MCDV among the inbred lines and hybrids tested.

Table 11.—Incidence of maize dwarf mosaic virus (MDMV) on inbred lines in the North Central Corn Breeding Research Committee uniform test on July 14, 1977

Inbred	MDM-%	
Oh7B	0	a [1/]
Oh5145	11.5	a-b
B75	17.7	a-c
H99	19.4	a-d
SD534-213	20.0	a-d
Ia76:1258	22.8	a-d
Oh51A	26.2	a-e
Mich.76-2	30.2	a-f
B84	36.4	b-g
Oh61658	39.5	b-g
SD504-322	40.9	b-g
NG72309	41.8	b-g
SD509-125P	45.5	b-h
Pa373	45.9	b-h
B14	46.3	c-i
(A251xMex Syn17)-S-- [12/]	50.8	c-j
Pa864P	53.6	d-j
H100	58.4	e-k
Mich.76-1	59.4	e-k
Pa865P	60.2	e-l
(B57xB46)-S-- [12/]	64.2	f-l
B37	64.4	f-l
ND75-1	67.1	g-l
B79	67.5	g-l
Pa374	68.6	g-l
(B8xB37)-S-- [11/]	76.8	h-l
W117	78.5	h-l
A74-4	78.5	h-l
ND75-3	79.6	h-l
A74-3	80.1	i-l
W64A	81.1	j-l
Mich.76-4	81.6	j-l
Mich.76-3	83.0	j-l
Pa871	83.2	j-l
H98	83.2	j-l
W153R	85.0	j-l
A74-2	88.5	k-l
Oh43	88.9	k-l
Pa872	89.8	k-l
WF9	92.6	k-l
SD511-2133	93.4	k-l
H55	95.1	l
Coefficient of variation	24.2%	
Least significant difference	29.0	

[1] Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

Table 12.—Incidence of maize chlorotic dwarf virus (MCDV) on inbred lines in the North Central Corn Breeding Research Committee uniform test on July 14, 1977

Inbred	MCD-%	
Oh7B	4.8	a [1/]
H99	36.5	b
SD534-213	44.0	b-c
Mich. 76-2	55.8	c-d
Mich. 76-1	57.1	c-e
Ia76:1258	57.4	c-f
B84	61.4	c-g
NG72309	61.6	c-g
Oh5145	61.7	c-g
Oh51A	61.9	c-g
B79	61.9	c-g
(B57xB46)-S-- [12/]	64.2	d-h
SD504-322	65.9	d-i
W117	66.0	d-i
B75	66.6	d-i
W153R	67.5	d-i
Pa373	71.7	d-j
(B8xB37)-S-- [11/]	72.1	d-j
Pa374	72.3	d-j
Pa864P	77.7	e-k
Oh43	77.8	e-k
Oh61658	79.0	f-l
Pa865P	79.2	g-l
Mich.76-3	80.1	g-l
(A251xMex Syn17)-S-- [12/]	82.0	g-l
H98	83.2	g-l
W64A	84.2	h-l
SD509-125P	84.4	h-l
B14	84.9	h-l
A74-4	86.9	i-l
ND75-1	90.5	j-l
H100	90.9	j-l
Pa871	91.3	j-l
Mich.76-4	92.5	j-l
Pa872	93.5	j-l
A74-3	95.1	k-l
SD511-2133	95.7	k-l
B37	95.8	k-l
WF9	97.4	k-l
A74-2	98.2	k-l
H55	100.0	l
ND75-3	100.0	l
Cofficient of variation	11.9%	
Least significant difference	18.0	

[1] Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

Table 13.—Virus ratings on inbred lines in the North Central Corn Breeding Research Committee uniform test on August 18, 1977

Inbred	Virus rating	
Oh7B	4.3	a[1/]
Mich. 76-1	4.5	a
Mich. 76-2	4.5	a
H99	4.5	a
SD534-213	5.3	a-b
Ia76:1258	5.5	a-b
B79	5.5	a-b
Oh5145	5.5	a-b
Mich. 76-3	6.0	a-c
Oh43	6.5	b-d
W64A	6.5	b-d
A74-4	6.5	b-d
WF9	6.5	b-d
Pa872	6.5	b-d
W117	7.0	b-e
SD504-322	7.0	b-e
SD509-125P	7.0	b-e
Pa374	7.0	b-e
Oh51A	7.0	b-e
NG72309	7.0	b-e
B75	7.0	b-e
Oh61658	7.0	b-e
Pa864P	7.0	b-e
Pa871	7.0	b-e
(B8xB37)-S--[11/]	7.0	b-e
(A251xMex Syn17)S--[12/]	7.0	b-e
(B57xB46)-S--[12/]	7.0	b-e
B84	7.0	b-e
W153R	7.5	c-f
SD511-2133	7.5	c-f
Pa373	7.5	c-f
A74-3	7.5	c-f
B14	7.5	c-f
B37	7.5	c-f
H98	7.5	c-f
ND75-1	7.5	c-f
Mich. 76-4	8.0	d-f
H100	8.0	d-f
Pa865P	8.0	d-f
ND75-3	8.0	d-f
A74-2	8.5	e-f
H55	9.0	f
Coefficient of variation	11.1%	
Least significant difference	1.5	

[1]Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

Table 14.—Incidence of maize dwarf mosaic virus (MDMV) on commercial and open-pedigree hybrids on July 22, 1977

Hybrid	MDM-%	
Mo17xT232	0	a[1/]
PAG SX17A	0	a
PAG Exp.246006	0	a
Landmark C787XX	0	a
Funks 28236W	0	a
Oh5739xH95	0	a
Madison Exp.E	0	a
Oh514x76:P815	0	a
Oh74-5232xOh514Ht$_1$B	.4	a
Hiser H91	.4	a
DeKalb XL72B	.4	a
PAG Exp.466001	.4	a
Pfizer Genetics T1191	.4	a
Funks G4776	.4	a
Baldridge Exp.4400	.4	a
(H95xOh7B)xOh514	.7	a-b
(Oh7BxMo12)(Va35xCI.38B)	.7	a-b
PAG Exp.232020	.7	a-b
Funks G27970	.7	a-b
Funks G4747W	.7	a-b
Madison Exp.C	.8	a-b
Pioneer 3179	1.0	a-b
Pioneer 3147	1.1	a-b
Funks G4525	1.1	a-b
Baldridge Exp. 4600	1.1	a-b
Baldridge Exp.4650	1.1	a-b
Baldridge Exp.4450	1.4	a-b
Madison Exp.A	1.4	a-b
Columbiana XC9016	1.5	a-b
Mo17xOh514	1.8	a-b
PAG 99W	1.8	a-b
(Oh509AxOh7B)xH95	2.1	a-c
Voris 2551	2.1	a-c
Madison Exp.D	2.7	a-c
Columbiana XC7014	3.0	a-c
Columbiana H2660W	3.0	a-c
Ruffs R434	3.2	a-c
Columbiana H2740A	3.2	a-c
Baldridge D335	3.2	a-c
Pioneer 3145	3.3	a-c
Baldridge Exp.4500	3.6	a-c
Pfizer Genetics MDM 116	4.0	a-c
Madison Exp.B	4.2	a-c
Ferry-Morse X-990	4.4	a-c
Ferry-Morse 74-174	5.6	a-d
Voris 2502	6.2	a-d
Acco UC9792	7.2	a-d
Moews SM725	8.0	a-d
Baldridge Exp.4550	8.9	b-d
Baldridge D46	10.1	c-d
Baldridge D5150	12.2	d
Ferry-Morse X-980	21.3	e
PAG 949	23.7	e
Baldridge D7475	24.8	e
PAG 314	26.4	e
PAG SX98	33.6	f
WF9xOh51A	60.6	g
Coefficient of variation	86.7%	
Least significant difference	6.7	

[1]Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

Table 15.—Incidence of maize chlorotic dwarf virus (MCDV) on commercial and open-pedigree hybrids on July 22, 1977

Hybrid	MCD-%	
Madison Exp.E	3.1	a[1/]
Funks G4525	5.0	a-b
Landmark C787XX	5.3	a-b
DeKalb XL72B	5.6	a-b
Voris 2551	8.6	a-c
(Oh509AxOh7B)xH95	9.2	a-d
Hiser H91	9.2	a-d
Oh514x76:P815	10.1	a-e
Mo17xT232	10.2	a-e
Pfizer Genetics MDM116	10.2	a-e
Madison Exp.B	10.5	a-f
Pfizer Genetics T1191	11.6	a-f
PAG SX17A	12.0	a-g
Funks 27970	12.2	a-g
Columbiana XC7014	12.7	a-h
Madison Exp.C	13.1	a-h
Baldridge Exp.4600	13.4	a-h
Baldridge Exp.4450	13.9	a-h
PAG Exp.466001	14.5	a-h
Oh74-5232xOh514 Ht_1B	14.9	a-i
Baldrige Exp.4400	15.7	a-j
(H95xOh7B)xOh514	16.4	a-k
Ruffs R434	17.0	a-k
Funks 28236W	17.6	a-k
Columbiana XC9016	17.7	a-k
Oh5379xH95	18.1	a-l
Madison Exp.A	18.1	a-l
Madison Exp.D	18.2	a-l
Voris V2502	18.4	a-l
Baldridge Exp.4650	18.8	a-m
Mo17xOh514	21.2	a-n
Pioneer 3147	21.7	b-n
Funks G4776	22.2	b-n
PAG Exp.232020	22.8	b-n
(Oh7BxMo12)(Va35xCI.38B)	23.1	b-n
Moews SM725	26.2	c-o
Baldridge D46	26.8	d-p
Funks G4747W	27.5	e-p
PAG 99W	27.6	e-p
Pioneer 3179	27.6	e-p
Ferry-Morse X-990	27.7	e-p
Acco UC9792	28.3	f-p
Columbiana H2660W	29.8	g-q
Pioneer 3145	30.8	h-q
Baldridge D335	32.7	i-q
Ferry-Morse 74-174	33.3	j-q
Baldridge Exp.4500	34.3	k-q
Baldridge Exp.4550	36.1	l-q
PAG Exp.246006	36.5	m-q
Columbiana H2740A	37.5	n-q
Baldridge D5150	37.9	n-q
Ferry-Morse X-980	38.1	n-q
PAG SX98	43.8	o-r
Baldridge D7475	44.3	p-r
WF9xOh51A	47.1	q-r
PAG 949	58.0	r
PAG 314	59.3	r
Coefficient of variation	46.1%	
Least significant difference	14.7	

[1]Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

Table 16.—Virus ratings on commercial and open-pedigree hybrids on August 18, 1977

Hybrid	Virus rating	
Mo17xT232	3.0	a[1/]
(Oh509AxOh7B)xH95	3.0	a
Hiser H91	3.0	a
PAG SX17A	3.0	a
Landmark C787XX	3.0	a
Pioneer 3179	3.0	a
Pfizer Genetics MDM 116	3.0	a
Funks G4525	3.0	a
Baldridge Exp. 4450	3.0	a
Madison Exp.A	3.0	a
Madison Exp.E	3.0	a
(H95xOh7B)xOh514	3.1	a-b
Oh74-5232xOh514 Ht_1B	3.1	a-b
DeKalb XL72B	3.1	a-b
PAG Exp.232020	3.1	a-b
PAG Exp.466001	3.1	a-b
Funks 27970	3.1	a-b
Columbiana XC7014	3.1	a-b
Baldridge Exp. 4400	3.1	a-b
Oh5739xH95	3.1	a-b
Madison Exp. B	3.1	a-b
Voris 2551	3.3	a-c
Pfizer Genetics T1191	3.3	a-c
Funks G4776	3.3	a-c
Funks 28236W	3.3	a-c
Columbiana XC9016	3.3	a-c
Baldridge Exp.4600	3.3	a-c
Oh514x76:P815	3.3	a-c
Ruffs R434	3.4	a-c
PAG Exp.246006	3.4	a-c
Pioneer 3147	3.4	a-c
Funks G4747W	3.4	a-c
Madison Exp. C	3.4	a-c
Mo17xOh514	3.5	a-c
Baldridge Exp. 4650	3.5	a-c
(Oh7BxMo12)(Va35xCI.38B)	3.6	a-d
Ferry-Morse X-990	3.6	a-d
Baldridge Exp.4500	3.6	a-d
Columbiana H2660W	3.8	b-d
Baldridge D335	3.8	b-d
Ferry-Morse 74-174	3.9	c-d
Acco UC9792	3.9	c-d
Madison Exp.D	3.9	c-d
Baldridge D7475	4.0	c-d
Baldridge Exp. 4550	4.0	c-d
Voris 2502	4.3	d-e
Pioneer 3145	4.3	d-e
Moews SM725	4.4	e
PAG 99W	4.4	e
Columbiana H2740A	4.4	e
Baldridge D5150	4.4	e
Ferry-Morse X-980	4.8	e-f
Baldridge D46	4.8	e-f
PAG SX98	5.1	f
WF9xOh51A	5.9	g
PAG 949	6.1	g
PAG 314	7.3	h
Coeffieient of variation	15.0%	
Least significant difference	0.8	

[1]Duncan's Multiple Range Test--Entries with the same letter in common are not considered significantly different at the 5% level.

GPO 818-969

U. S. DEPARTMENT OF AGRICULTURE
SCIENCE AND EDUCATION ADMINISTRATION
NORTH CENTRAL REGION
PIONEER INDUSTRIAL PARK
2000 WEST PIONEER PARKWAY
PEORIA, ILLINOIS 61614

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF
AGRICULTURE
AGR 101